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CENTRAL INTELLIGENCE AGENCY

12 October 1949

INTELLIGENCE MEMORANDUM NO. 236

SUBJECT: Capabilities of the USSR for Operational Employment of Airborne Radar for Night Fighter Aircraft

<u>Discussion:</u>

It should be borne in mind that there is little or no positive intelligence on Russian developments or capabilities in AI radar as such. What the following estimate is based upon is extrapolation from the slender amount of available information summarized in Appendix A.

Part I. <u>1 May 1950</u>

On the given date the USSR will probably have sufficient numbers of active AI equipment to provide 100-200 equipped night fighters. These equipments will largely be former lend-leased sets of British or American make as detailed elsewhere. It may be assumed that spare tubes, magnetrons, TR-tubes, etc., have either been stockpiled from World War II or have been purchased by secondary agents from sales of US surplus stores. The operation of these sets at high altitudes and low temperatures may involve special techniques in pressurization, but these are believed to be within the Soviet capabilities.

The Soviets <u>may</u> have an undetermined number of <u>passive</u> AI-equipped aircraft. There is no positive intelligence on this at all but, should passive AI sets prove to exist, the problems involved in tactical radar/radio silence will make them a most important intelligence target.

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The Soviets probably will have available a native IFF similar to the U.S. Mk III and possibly one similar to the U.S. Mk V. If passive AI detection is used, no IFF problem exists.

There is no positive indication that night fighters will be equipped with tail-warning equipment.

It is unlikely that ECM will be employed by night fighters because of limitation of space, extreme speeds and consequently short time of contact and intercept, and other demands on pilot's or radar operator's attention. It must be presumed, however, that the USSR possesses adequate ECM knowledge to activate such a phase as necessary.

Part II. 1 May 1953

The USSR will probably have available active AI equipment at X-band in unknown numbers, but with the numbers probably restricted by the number of aircraft and adequately trained personnel rather than by the electronic gear. Effective research on X-band magnetrons and hard-tube modulators in the Soviet Zone of Germany suggest that vigorous efforts are being made on airborne X-band radar.

The USSR may have passive AI equipment in unknown but large numbers.

The USSR will probably have IFF equipment in operational use at least equivalent to the U.S. Mk V IFF set.

The USSR may provide night fighters with tail-warning equipment.

Part III. 1 May 1956

The situation will be substantially the same as on 1 May 1953.

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APPENDIX A

Substance of Intelligence on Airborne Radar for Night Fighters

I. Present Soviet Position in AI Radar.

It is known that the USSR received a number (about 120) of U.S. and British AI radar sets on lend-lease, and in addition captured or liberated an undetermined number of German and Japanese sets. The former are listed elsewhere. The latter consist of the Lichtenstein, Neptune and the Panke. Ferret and Rine reports have identified the majority of the Soviet radar signals as coming from sets of both categories. Although this situation applies largely to Early Warning and GCI, it is not unreasonable to expect the Soviets to make just as vigorous use of foreign AI radar sets available to them. It is also probable that initially the Soviets will rely on U.S. and British airborne gear even more than on foreign ground-based and ship-based equipment (almost all of latter so far identified turn out to be U.S. or British) because of the limitations in space, weight, and power -- in the engineering of which the U.S. sets are probably (although not certainly) more advanced than are the Russian sets at the present time. This leadership cannot be presumed to continue indefinitely, however, as is hinted by the description of the Soviet IFF set below.

Among the EW and GCI signals are a number which do not correspond to any U.S., British, German, or Japanese sets known to be in Russian hands. These signals are spotted between 113 and 9375 Mc/sec. This supports the position that the Soviets do produce some of their own radar gear, indeed including X-band. These higher frequencies (one at S-band and one at X-band

actually detected) and the fact that some German Rotterdam blind-bombing radars on S-band have been produced for the Soviets in Occupied Germany also support the prediction of active airborne radar and the possibility of native Russian AI radar under development.

During the last few months of World War II, Soviet soldiers captured by the Germans started to make numerous references to night fighters equipped with AI radar. This early equipment was of Soviet design, very crude, and operated at only 200 Mc/sec. It employed an antenna consisting of 4 quarter-wave dipoles, two vertical and two horizontal. Lobe-switching was used. There is further scattered evidence all to the effect that the Soviets intend operational use of AI radar: there are reports that fighter aircraft recently are fitted with airborne radar (no details given); more intensive night flying at fields occupied by Soviet fighters has been observed. On the other hand, neither radomes nor radar antennas have yet been identified on the new Soviet fighters which have been seen so far by our observers.

No details of any new Russian AI radar sets are known, although there is some information concerning the crude and obsolete 200 Mc/sec Russian airborne set already mentioned.

II. Present Soviet Position in IFF

A new Soviet IFF set, the SCH-3-(m), which is comparatively simple, small and compact, has been observed. It uses a built-in dynamotor furnishing the d-c voltage and also to drive the frequency-sweeping mechanism, much the same as in the U.S. Mark III IFF set. The Soviet equipment, however,

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appears to be 1/3 the size of our Mark III set. It consists of a 3-tube transponder using either 2 6K7 tubes or 1 6K7 and 1 6L7 in the receiver portion, and 1 6L6 in the transmitter. The maximum frequency sweep is 65 to 86 Mc/sec and the minimum was found to be 71.8 to 82.2 Mc/sec. The sweep occurs once every 2.5 sec. A five-position rotary switch furnishes the coding. The sweep duration is 2.5 sec, pulse width 12 μ sec, sensitivity 5 mw, and the frequency is changed in accordance with a pre-arranged code. The antenna is similar to that used in the British Mark II IFF system, using a shunt feed to a horizontal portion of the aircraft tail assembly; the installation is thus hard to identify because of the absence of noticeable insulators in the assembly. These sets are believed to be produced at a rate of several hundred per day.

There is a suggestion of Russian IFF at 1375-1380 Mc/sec, from one signal intercept where the signal had IFF characteristics; also one at 1265 Mc/sec.

The possibility of the Russians having an IFF set similar to the U.S. Mark V comes largely from the conviction in Canada of E. W. Mazerall of disclosing secrets to the USSR. He was known to have had access to data on the U.S. Mark V IFF. It is likely therefore that the USSR is either developing our Mark V set or one of their own with similar features.

III. Present Soviet Position with Regard to Tubes.

Most of our knowledge of Soviet tube-development efforts comes from the exploitation of the Oberspreewerke in the Soviet Zone of Germany. The peak of the OSW tube-development effort lies at 3 cm (X-band), where they

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are developing several low-power and medium-power (30-60 kw) magnetrons. One high power S-band tube (1 Megawatt) is being developed, as well as one 250-watt S-band tube (the latter probably for countermeasures). The only X-band magnetrons under development are low-power tubes. Low-power metal-ceramic tubes and klystrons from X- to L- bands are also being developed. A further significant fact is that much effort is being put into developing the 5D21 (hard-tube pulse modulator) in spite of many difficulties. This last tube suggests strongly efforts on airborne radar, for, if space and weight were no object, other means of modulating ground or shipborne sets could readily be employed.

The indication of this slender evidence supported by other known research on PPI, test gear, etc., is that the Soviets are making serious efforts to develop airborne radar in the X-band region. Such radar would probably include AI.

The Soviets are known to have purchased surplus U.S. electronic gear, either directly, or indirectly through principals of other nations. It is entirely reasonable to suppose that the USSR has no lack of magnetrons, either S-band or X-band, modulators, TR-tubes, hardware, etc., all of which could have been readily purchased at low prices.

IV. Present Soviet Position with regard to ECM.

It is known that German ECM experts are working in the USSR and that the Germans had adequate, well-developed ECM gear from 15 Mc/sec up to S-band by the end of World War II. It may be assumed that this potential is at the disposal of the Soviets.

The rapidity with which U.S. surplus ECM gear disappeared from the surplus sales market makes it suspiciously probable that the USSR obtained much of it.

V. Soviet Position with Regard to Passive AI Radar.

Passive detection was well developed by the Germans and consequently must be assumed to be known to the Russians. The Germans first homed on British blind-bombing radar in 1943. They developed gear to home on tail-warning radar, navigational radar, bombing radar and ECM. The German "Flensberg" set was developed for homing on the British tail-warning sets on 230 Mc/sec. British tests of this set showed that it was capable of homing on the bomber screen, cutting out a single bomber, and completing the interception.

There are a number of advantages to the Russians in employing passive AI. In the first place, IFF can be dispensed with. Then, too, the sets are less costly in terms of manpower. The maximum range greatly exceeds that of active AI, and may be 100-200 miles. While a forward-sector scan reduces the possibility of homing on bombing or navigational radar, the operation of a tail-warning radar on the attacking bomber would still allow homing and interception by the enemy. Although only bearing, not range, is given by passive AI sets, the latter could conceivably be obtained by various tricks. For example, the Germans used "Naxos" against the H_2S and H_2X blind-bombing radars. Since they knew the characteristics of their radiation patterns ($cosec^2$), the interceptor climbed until reception was lost, noted the altitude, and then estimated the range. The Soviets have data, by lend-lease or open publication, on the following

U.S. airborne radars:

SCR 720	AI
SCR 717B	ASV
SCR 520	AI
SCR 535	AI
AN/APQ-13	Blind-bombing and Navigational
AN/APS-15	" " " "
AN/APG-1	AI and GL
AN/APG-2	AI
AN/APS-10	Navigation
AN/APG-13	Fire Control

Technical publications, military releases, and press have covered the details concerning function, size, weight, wavelength, peak power, pulse repetition frequency, antenna size and gain, type of scan, beam width, scan rate, receiver sensitivity and bandwidth, maximum range, minimum accuracy, range accuracy, and angular accuracy of almost all equipment developed in World War II. The Soviets are thus armed with considerable data, including the definite indication that we put the weight of emphasis on X-band (note Soviet emphasis on X-band tubes above).

No intelligence currently exists on possible Soviet passive AI. The importance of the possibility, the tactics of radar silence that would be imposed if the possibility became a reality, emphasizes the need to study further this subject. From knowledge of the capabilities of Germans working for the Russians, from the known capabilities of the Russians themselves, passive AI must be considered a distinct possibility.

VI. The Soviet Position with regard to Tail-Warning Equipment.

The Soviets have tail-warning equipment of their own design, TON-2, operating probably at 200 Mc/sec; the observation was probably of an experimental unit fitted to a TU-2 aircraft. The characteristics of this

early set are:

Wavelength	150 cm
Peak power	600 watts
Pulse width	1.5 μ-sec
Pulse repetition frequency	250 per sec
Effective range	1500 meters
"Dead zone"	200 meters (at this range, warning note ceases to be interrupted and becomes a steady buzz)
Weight	47 kg
Antenna	Yagi

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